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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,085	11/09/2001	Raymond J. Gorte	PENN.N2437 C	5527
21967	7590	11/02/2004	EXAMINER	
HUNTON & WILLIAMS LLP INTELLECTUAL PROPERTY DEPARTMENT 1900 K STREET, N.W. SUITE 1200 WASHINGTON, DC 20006-1109			YUAN, DAH WEI D	
			ART UNIT	PAPER NUMBER
			1745	

DATE MAILED: 11/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/053,085	GORTE ET AL.	
	Examiner	Art Unit	
	Dah-Wei D. Yuan	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 and 54 is/are pending in the application.
- 4a) Of the above claim(s) 54 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 November 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>08112004</u> . | 6) <input type="checkbox"/> Other: _____ |

Art Unit: 1745

**THE USE OF SULFUR-CONTAINING FUELS FOR
DIRECT OXIDATION FUEL CELLS**

Examiner: Yuan S.N. 10/053,085 Art Unit: 1745 October 27, 2004

Detailed Action

1. The Applicant's amendment filed on August 11, 2004 was received. Claims 1,20 were amended. Claim 54 was added.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued May 11, 2004.

Election/Restrictions

3. Newly submitted claim 54 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The subject matter of aforementioned claims is "a solid oxide fuel cell comprising a solid electrolyte comprised of a ceramic-metal composite anode containing at least copper and a cathode", which is a distinct species from the "a solid oxide fuel cell comprising a solid electrolyte comprised of a ceramic-metal composite anode containing at least ceria and a cathode" as recited in the original claims.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claim 54 is withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 112

4. The claim rejections under 35 U.S.C. 112, second paragraph, on claims 1-30 are withdrawn, because the independent claims 1,20 have been amended.

Claim Rejections - 35 USC § 103

5. Claims 1-6,9-27,30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647) in view of Anumakonda et al. (US 6,221,280).

With respect to claim 1, Wallin teaches a solid oxide fuel cell comprising a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite comprising an ionically conductive material. Suitable ionically conductive materials include yttria stabilized zirconia, ytterbium stabilized zirconia, scandium-doped zirconia, ceria, gadolinium-doped ceria. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.; Column 3, Lines 6-37; Column 4, Lines 31-59; Example 1.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Anumakonda et al. teach the use of sulfur-containing heavy hydrocarbon fuels for a solid oxide fuel cell. The hydrocarbon fuel is a liquid hydrocarbon having at least six carbon atoms and a sulfur content of at least 50 ppm. In one

embodiment, the JP-8 fuel has a sulfur content of about 3000 ppm. The feed, containing the vaporized fuel and oxygen, is partially oxidized by a catalytic reaction to convert the hydrocarbon to hydrogen and carbon monoxide. As a result, the use of catalytic partial oxidation process to produce fuel enables a simplified overall system design. Furthermore, the product gas can be used as a fuel for a fuel cell system, either directly or after treatment for desulfurization. See Abstract, Column 1, Lines 11-15; Column 4, Lines 7-9,35-39, Column 8, Lines 36-42; Column 11, Lines 58-62. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at least 50 ppm to about 3000 ppm on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-8, to simplify the overall design of a fuel cell system.

With respect to claims 2-6,9, Anumakonda et al. teach the conversion of refinery liquid hydrocarbon fuels, such as gasoline and naphtha, to hydrogen/carbon monoxide gas streams by partial oxidation process. The hydrocarbon fuels further comprises fuels, such as JP-4 jet fuel, JP-5 jet fuel, JP-8 jet fuel, No. 2 fuel oil, diesel oil, kerosene, and decane. See Column 2, Lines 6-18; Column 5, Lines 39-43; column 13, Lines 15-28. Therefore, it would have been obvious to one of ordinary skill in the art to use fuel, including jet fuel, gasoline, naphtha, fuel oil, diesel oil, kerosene, and decane, on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel can simplify the overall design of a fuel cell system.

With respect to claims 10-14, Anumakonda et al. teach the military specification for maximum sulfur content in logistic fuels, such as Jet A, JP-4, JP-5, and JP-8, is 0.3 wt% (3000

ppm). Typically, however, commercially available jet fuels have a total sulfur content of about 0.05-0.07 wt.% (500-700 ppm). See Column 2, Lines 38-44. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at about 500 to about 700 ppm on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-4, JP-5, and JP-8, can simplify the overall design of a fuel cell system.

With respect to claim 15, Wallin discloses the electrolyte membrane is a ceramic oxygen ion conductor. See Column 1, Lines 30-32.

With respect to claims 16-19, Wallin teaches suitable ionically conductive materials include doped zirconia such as yttria-stabilized zirconia, scandium-doped zirconia, gadolinium-doped ceria, and rare earth or alkaline earth-doped LaAGaO_3 . See Column 4, lines 49-59.

With respect to claim 20, Wallin teaches process to generate electrical energy by using a solid oxide fuel cell, which comprises a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Anumakonda et al. teach the use of sulfur-containing

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heavy hydrocarbon fuels for a solid oxide fuel cell. The hydrocarbon fuel is a liquid hydrocarbon having at least six carbon atoms and a sulfur content of at least 50 ppm. In one embodiment, the JP-8 fuel has a sulfur content of about 3000 ppm. The feed, containing the vaporized fuel and oxygen, is partially oxidized by a catalytic reaction to convert the hydrocarbon to hydrogen and carbon monoxide. As a result, the use of catalytic partial oxidation process to produce fuel enables a simplified overall system design. Furthermore, the product gas can be used as a fuel for a fuel cell system, either directly or after treatment for desulfurization. See Abstract, Column 1, Lines 11-15; Column 4, Lines 7-9,35-39, Column 8, Lines 36-42; Column 11, Lines 58-62. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at least 50 ppm to about 3000 ppm on the process of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-8, can simplify the overall design of a fuel cell system.

With respect to claims 21-27, Anumakonda et al. teach the conversion of refinery liquid hydrocarbon fuels, such as gasoline and naphtha, to hydrogen/carbon monoxide gas streams by partial oxidation process. The hydrocarbon fuels further comprises fuels, such as JP-4 jet fuel, JP-5 jet fuel, JP-8 jet fuel, No. 2 fuel oil, diesel oil, kerosene and decane. See Column 2, Lines 6-18; Column 9, Lines 1-4; column 13, Lines 15-28. Therefore, it would have been obvious to one of ordinary skill in the art to use fuel, including jet fuel, gasoline, naphtha, fuel oil, diesel oil, kerosene and decane, on the process of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel can simplify the overall design of a fuel cell system.

With respect to claim 30, Anumakonda et al. teach the military specification for maximum sulfur content in logistic fuels, such as Jet A, JP-4, JP-5, and JP-8, is 0.3 wt% (3000 ppm). Typically, however, commercially available jet fuels have a total sulfur content of about 0.05-0.07 wt.% (500-700 ppm). See Column 2, Lines 38-44. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at about 500 to about 700 ppm on the process of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-4, JP-5, and JP-8, can simplify the overall design of a fuel cell system.

6. Claims 1,2,7,8,20,28,29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647) in view of Fasano et al. (US 6,051,330).

With respect to claims 1,2,7,8, Wallin teaches a solid oxide fuel cell comprising a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite comprising an ionically conductive material. Suitable ionically conductive materials include yttria stabilized zirconia, ytterbium stabilized zirconia, scandium-doped zirconia, ceria, gadolinium-doped ceria. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42. However, Wallin does not disclose the

characteristics of the fuel used for the aforementioned solid oxide fuel cell. Fasano et al. teach the use of light hydrocarbons, such as methane, propane, ethanol and methanol, as fuel for a solid oxide fuel cell because they produce less carbonaceous material build-up in the anode. The light hydrocarbons are used without any prior treatment to reduce the sulfur content. See Column 1, Lines 5-8, 61 to Column 2, Line 2. Fasano et al. do not specifically disclose the sulfur content in the fuel. However, it is the position of the examiner that such characteristic is inherent, given that both Fasano et al. and the present application utilize similar alcohols, including methanol and ethanol. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature *is necessarily present in that which is described in the reference*. In re Robertson, 49 USPQ2d 1949 (1999). Therefore, it would have been obvious to one of ordinary skill in the art to use a light hydrocarbon fuel, such as methanol (or ethanol) having sulfur content from about 1 ppm to about 5000 ppm on the solid oxide fuel cell of Wallin, because Fasano et al. teach the use of a light hydrocarbon fuel can reduce the build-up of carbonaceous material in the anode of a solid oxide fuel cell. Alternatively, it would have been within the skill of the ordinary artisan to lower the production cost of alcohol by eliminating the desulfurization process because one of ordinary skill in the fuel cell art would recognize it is cost-effective to use alcohol having relative high sulfur content (> 1 ppm) as fuel for a solid oxide fuel cell.

With respect to claims 20,28,29, Wallin teaches a process to generate electrical energy by using a solid oxide fuel cell, which comprises a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell,

and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Fasano et al. teach the use of light hydrocarbons, such as methane, propane, ethanol and methanol, as fuel for a solid oxide fuel cell because they produce less carbonaceous material build-up in the anode. See Column 1, Lines 5-8, 61 to Column 2, Line 2. Fasano et al. do not specifically disclose the sulfur content in the fuel. However, it is the position of the examiner that such characteristic is inherent, given that both Fasano et al. and the present application utilize similar alcohols, including methanol and ethanol. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is *necessarily present in that which is described in the reference*. In re Robertson, 49 USPQ2d 1949 (1999). Therefore, it would have been obvious to one of ordinary skill in the art to use a light hydrocarbon fuel, such as methanol having a sulfur content of from 1 ppm to about 5000 ppm on the process of Wallin, because Fasano et al. teach the use of a light hydrocarbon fuel can reduce the build-up of carbonaceous material in the anode of a solid oxide fuel cell. Alternatively, it would have been within the skill of the ordinary artisan to lower the production cost of alcohol by eliminating the desulfurization process because one of ordinary skill in the

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fuel cell art would recognize it is cost-effective to use alcohol having relative high sulfur content (> 1 ppm) as fuel in a fuel cell that produces electrical energy.

Response to Arguments

7. Applicant's arguments filed on August 11, 2004 have been fully considered but they are not persuasive.

Applicant's principle arguments are

(a) The solid oxide fuel cell of Wallin and Anumakonda does not contain a sulfur-containing hydrocarbon because the product gas contains no sulfur – only hydrogen and carbon monoxide;

(b) the alcohols used in the present application are not similar to those described in Fasano.

In response to Applicant's arguments, please consider the following comments.

(a) Anumakonda et al. teach in the substantial absence of steam and/or desulfurization, the fuel system can product a reaction product gas stream comprising hydrogen and carbon monoxide as the main reaction products. In turn, the product gas can be used a fuel for a fuel cell system, either directly (a sulfur-containing hydrocarbon fuel) or after treatment for desulfurization or temperature compatibility by routing it to a fuel cell system such as a solid oxide fuel cell system. See Column 8, Lines 36-47;

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(b) Fasano teaches the fuel used includes light hydrocarbons such as methane, propane, ethanol and methanol. Heavier fuels such as JP8 and kerosene can also be used. The above listed fuels are similar to those disclosed in the instant specification (see Page 14, Lines 5-6). The instant disclosure provides no further description with respect to the nature and characteristic of the alcohols used. Therefore, it is concluded that intrinsic properties, including sulfur content, of the alcohol cited in the instant specification and Fasano are inherently similar.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dah-Wei D. Yuan
October 28, 2004

A handwritten signature in black ink, appearing to read 'Dah-Wei D. Yuan', followed by a horizontal line.